

CLAIMS

1. A process for recovering a target metal from an oxidised metalliferous material comprising the steps of:
 - in a leaching stage, leaching the oxidised metalliferous
 - 5 material with an acidic aqueous halide solution to leach the target metal into solution, the leaching solution being generated by adding sulfuric acid to a solution comprising a metal halide;
 - passing the solution from the leaching stage to a target
 - 10 metal recovery stage in which the target metal is recovered from the solution whilst the metal halide is retained in solution; and
 - returning the solution with the metal halide therein from the target metal recovery stage to the leaching
 - 15 stage.
2. A process as claimed in claim 1 wherein the metal of the metal halide solution is one that forms a precipitate with the sulfate anion of the sulfuric acid such that, with the generation of the leaching solution, a
- 20 hydrohalous acid forms together with a precipitate of the metal sulfate.
3. A process as claimed in claim 2 wherein the metal of the metal halide solution is calcium so that the metal sulfate precipitate is calcium sulfate.
- 25 4. A process as claimed in any one of the preceding claims wherein the halide of the metal halide solution is chloride.
5. A process as claimed in any one of the preceding claims wherein, when the oxidised metalliferous material
- 30 includes precious metal(s), the halide of the metal halide solution then comprises chloride and bromide.
6. A process as claimed in any one of the preceding claims wherein the leaching stage comprises first and

second leaching stages that operate in a counter-current configuration, whereby:

- the oxidised metalliferous material is added to the first leaching stage to contact the solution and leach target metal into solution; and
- the solution from the first leaching stage is separated from first leached solids and passed to the target metal recovery stage; and
- the first leached solids are passed to the second leaching stage to be mixed with the leaching solution; and
- the solution from the second leaching stage is separated from second leached solids and passed to the first leaching stage, and the second leached solids are discarded as residue.

7. A process as claimed in claim 6 wherein the leaching solution is generated in a separate hydrohalous acid generation stage in which the sulfuric acid is added to the solution comprising the metal halide, and this leaching solution is then fed to the second leaching stage to mix with the first leached solids.

8. A process as claimed in claim 7 wherein a portion of that solution being passed from the second to the first leaching stage is diverted to the hydrohalous acid generation stage to provide the solution comprising the metal halide, with the balance of leaching solution comprising solution of the added sulfuric acid.

9. A process as claimed in claim 7 or 8 wherein the metal of the metal halide solution is one that forms a precipitate with the sulfate anion of the sulfuric acid such that, with the generation of the leaching solution, a hydrohalous acid forms together with a precipitate of the metal sulfate, the metal sulfate precipitate being removed

as a solid residue stream from the hydrohalous acid generation stage.

10. A process as claimed in claim 6 wherein the sulfuric acid is added directly to the second leaching stage.

5 11. A process as claimed in claim 10 wherein the metal of the metal halide solution is one that forms a precipitate with the sulfate anion of the sulfuric acid such that, with the generation of the leaching solution, a hydrohalous acid forms together with a precipitate of the metal sulfate, the metal sulfate precipitate being removed
10 with the second leached solids and discarded as residue.

12. A process as claimed in any one of the preceding claims wherein the target metal recovery stage comprises a precipitation stage in which a precipitate of the target
15 metal is formed by adding a precipitation agent to the solution.

13. A process as claimed in claim 12 wherein the precipitation agent can include a metal that is the metal of the metal halide solution, such that addition of the
20 precipitation agent can maintain a desired concentration of that metal in solution.

14. A process as claimed in claim 12 or 13 wherein the oxidised metalliferous material comprises more than one target metal, and a respective precipitation stage is
25 provided for each target metal.

15. A process as claimed in any one of claims 12 to 14 wherein the oxidised metalliferous material includes iron, whereby a proportion of that iron is leached into solution in the leaching stage, with at least a proportion of the
30 leached iron then being precipitated in an iron precipitation stage as ferric oxide through the addition of calcium carbonate as the precipitation agent.

16. A process as claimed in claim 15 wherein the oxidised metalliferous material has sufficient residence time in the leaching stage such that leached iron can be oxidised through to haematite.

5 17. A process as claimed in any one of claims 12 to 16 wherein, when the target metal includes copper, the precious metal is precipitated in a copper precipitation stage by adding calcium carbonate as the precipitation agent.

10 18. A process as claimed in any one of claims 12 to 17 wherein, when the target metal includes a precious metal, the precious metal is precipitated in a precious metal precipitation stage by adding NaSH as the precipitation agent.

15 19. A process as claimed in any one of claims 12 to 18 wherein, when the target metal includes nickel and/or cobalt, the nickel and/or cobalt is precipitated in a nickel/cobalt precipitation stage by adding calcium hydroxide as the precipitation agent.

20 20. A process as claimed in any one of claims 12 to 19 wherein, when the target metal includes magnesium, the magnesium is precipitated in a magnesium precipitation stage by adding calcium hydroxide as the precipitation agent.

25 21. A process as claimed in claim 19 or 20 wherein the calcium hydroxide is slaked lime.

22. A process as claimed in any one of claims 1 to 11 wherein the target metal recovery stage comprises an electrolytic recovery stage, whereby the solution from the
30 leaching stage is passed to one or more electrolysis cells for metal recovery by electro-deposition.

23. A process as claimed in claim 22 wherein the oxidised metalliferous material comprises more than one target

metal, and a respective electrolytic recovery stage is provided for each target metal.

24. A process as claimed in any one of the preceding claims wherein the sulfuric acid is added to the leaching
5 stage to achieve a pH in the range 0 to 1 and a solution Eh of -600mV.

25. A process as claimed in any one of the preceding claims wherein the temperature of the solution in the leaching stage is in the range 85 - 95°C.

10 26. A process as claimed in any one of the preceding claims wherein, when the halide is chloride, total chloride concentration is in the range of 6 to 8 M.

27. A process as claimed in any one of the preceding claims wherein, when the halide is chloride and the
15 solution metal is calcium, at least 30g/l of CaCl_2 is maintained in the leaching stage.

28. A process for leaching a target metal from an oxidised metalliferous material, the process comprising first and second leaching stages in which an acidic
20 aqueous halide solution generated from sulfuric acid and used for leaching the target metal into solution passes counter-currently therethrough, wherein the acid generated from sulfuric acid is added to the second stage, and the oxidised metalliferous material is fed to the first
25 leaching stage and contacted with a recycle of residual acid in solution from the second leaching stage to leach the material and produce first leached solids, and wherein the solution is separated from the first leached solids and may be passed to target metal recovery, whereas the
30 first leached solids are passed to the second leaching stage for contact with the added acid for further leaching of the solids whilst producing the residual acid recycle solution.

29. A process as claimed in claim 28 wherein the acid generated from sulfuric acid is generated in a separate stage from the second leaching stage prior to being added thereto, or is generated in the second leaching stage.

5 30. A process as claimed in claim 28 or 29 wherein the oxidised metalliferous material includes iron such that a proportion of iron is leached into solution in the first leaching stage and precipitated as ferric oxide, the ferric oxide precipitate passing with the solids to the
10 second leaching stage.

31. A process as claimed in any one of claims 28 to 30 which is the leaching process as defined in any one of claims 1 to 27.

15 32. A target metal recovered by the process of any one of the preceding claims.